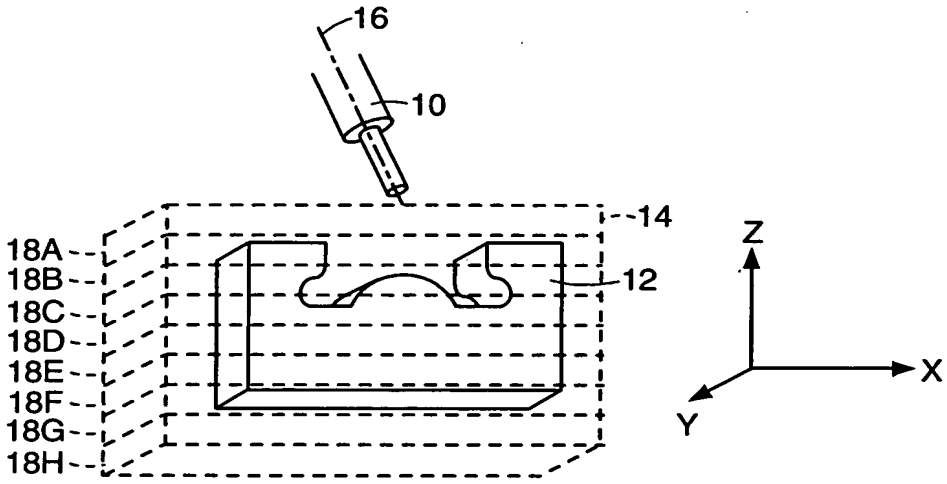

16
10
14
12
18A
18B
18C
18D
18E
18F
18G
18H
Z
X
Y

FIG. 1

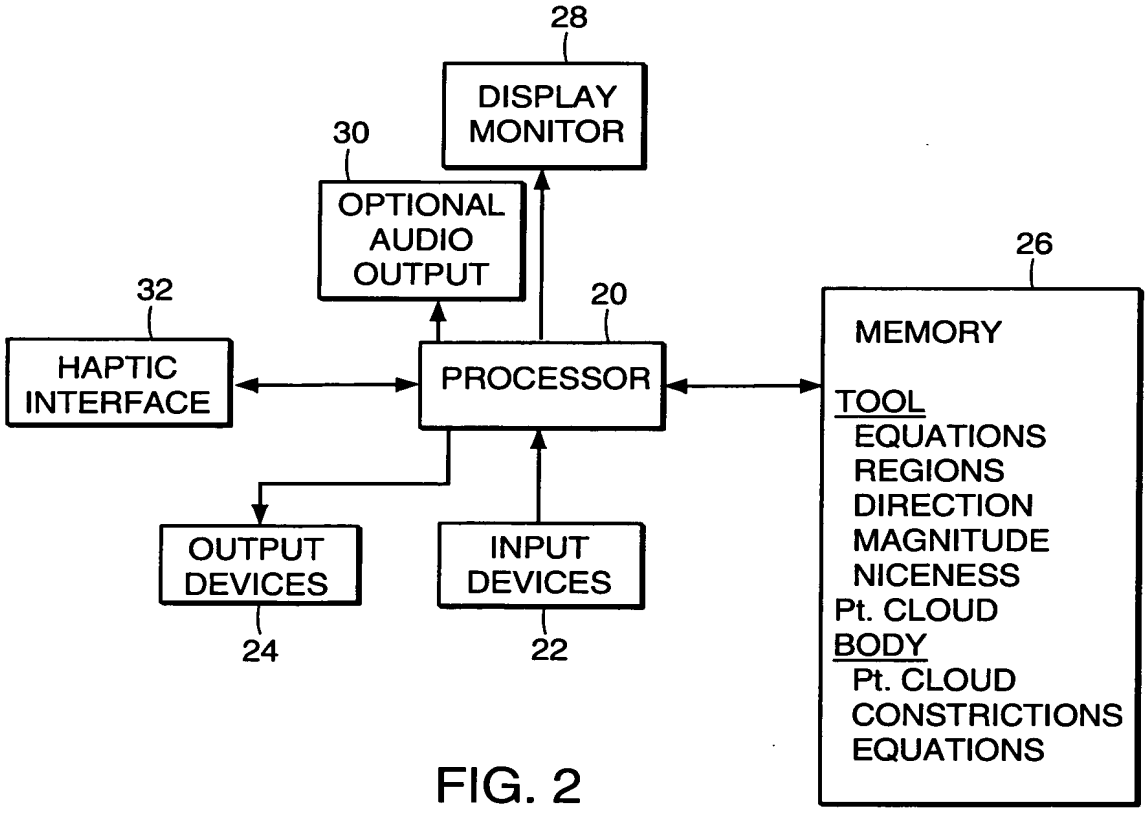

28
DISPLAY MONITOR
30
OPTIONAL AUDIO OUTPUT
32
HAPTIC INTERFACE
20
PROCESSOR
26
MEMORY
TOOL
EQUATIONS
REGIONS
DIRECTION
MAGNITUDE
NICENESS
Pt. CLOUD
BODY
Pt. CLOUD
CONSTRICTIONS
EQUATIONS
OUTPUT DEVICES
24
INPUT DEVICES
22

FIG. 2

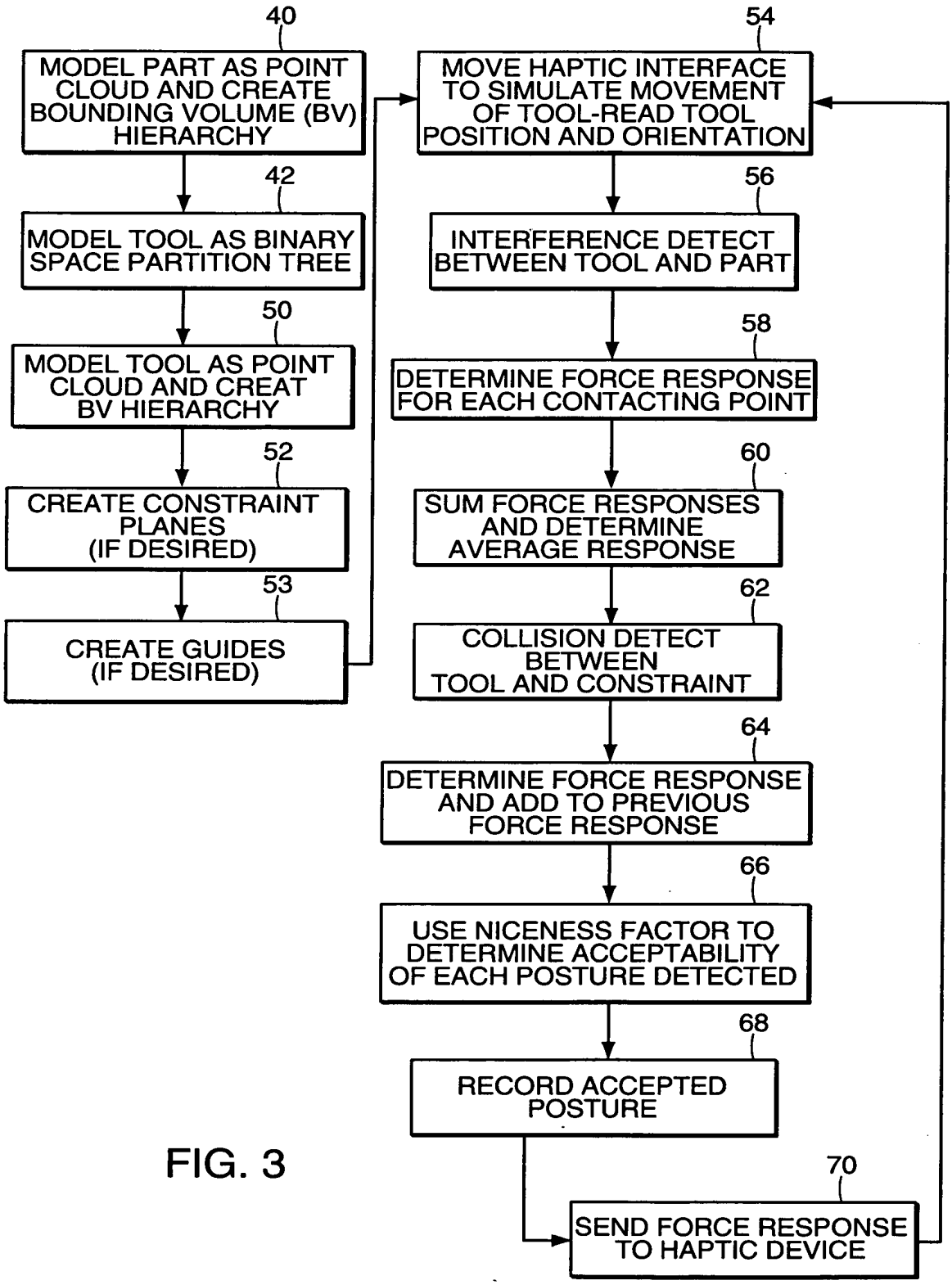

40
MODEL PART AS POINT CLOUD AND CREATE BOUNDING VOLUME (BV) HIERARCHY
42
MODEL TOOL AS BINARY SPACE PARTITION TREE
50
MODEL TOOL AS POINT CLOUD AND CREAT BV HIERARCHY
52
CREATE CONSTRAINT PLANES (IF DESIRED)
53
CREATE GUIDES (IF DESIRED)
54
MOVE HAPTIC INTERFACE TO SIMULATE MOVEMENT OF TOOL-READ TOOL POSITION AND ORIENTATION
56
INTERFERENCE DETECT BETWEEN TOOL AND PART
58
DETERMINE FORCE RESPONSE FOR EACH CONTACTING POINT
60
SUM FORCE RESPONSES AND DETERMINE AVERAGE RESPONSE
62
COLLISION DETECT BETWEEN TOOL AND CONSTRAINT
64
DETERMINE FORCE RESPONSE AND ADD TO PREVIOUS FORCE RESPONSE
66
USE NICENESS FACTOR TO DETERMINE ACCEPTABILITY OF EACH POSTURE DETECTED
68
RECORD ACCEPTED POSTURE
70
SEND FORCE RESPONSE TO HAPTIC DEVICE

FIG. 3

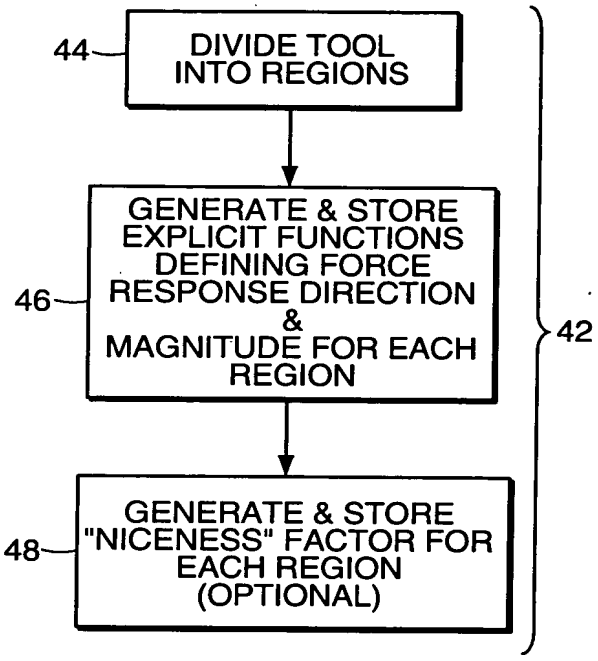

44
DIVIDE TOOL INTO REGIONS
46
GENERATE & STORE EXPLICIT FUNCTIONS DEFINING FORCE RESPONSE DIRECTION & MAGNITUDE FOR EACH REGION
48
GENERATE & STORE "NICENESS" FACTOR FOR EACH REGION (OPTIONAL)
42

FIG. 4

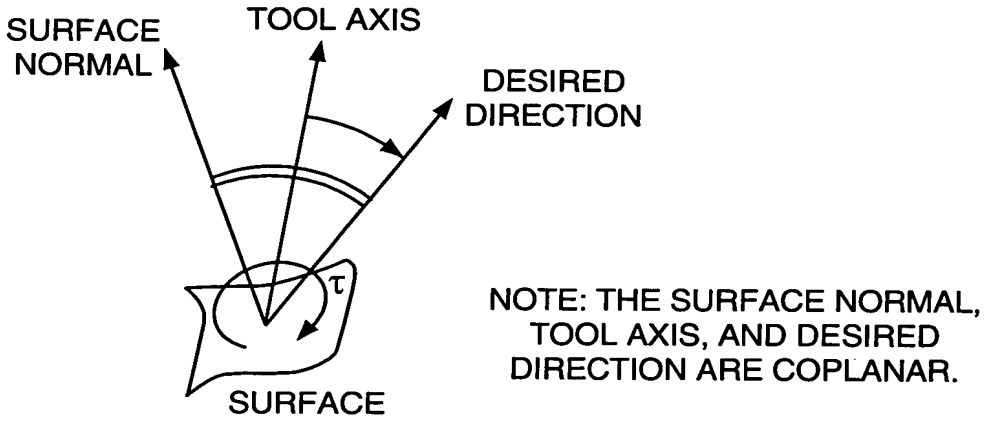
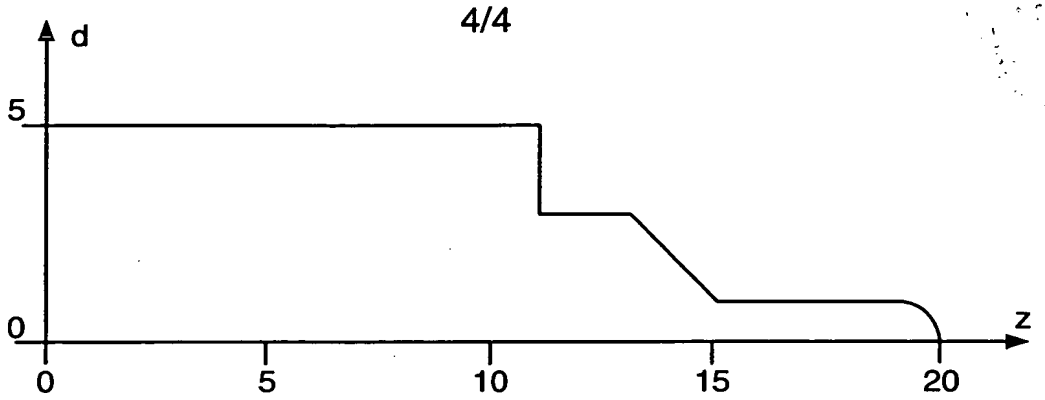
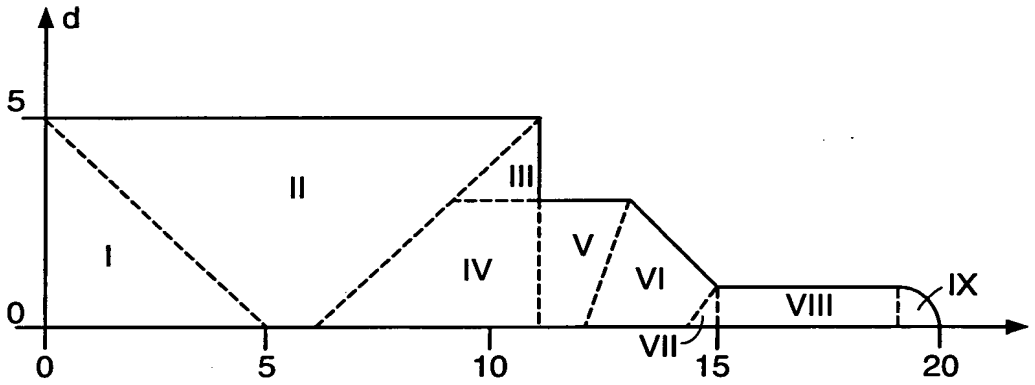

SURFACE NORMAL
TOOL AXIS
DESIRED DIRECTION
τ
SURFACE
NOTE: THE SURFACE NORMAL, TOOL AXIS, AND DESIRED DIRECTION ARE COPLANAR.

FIG. 6



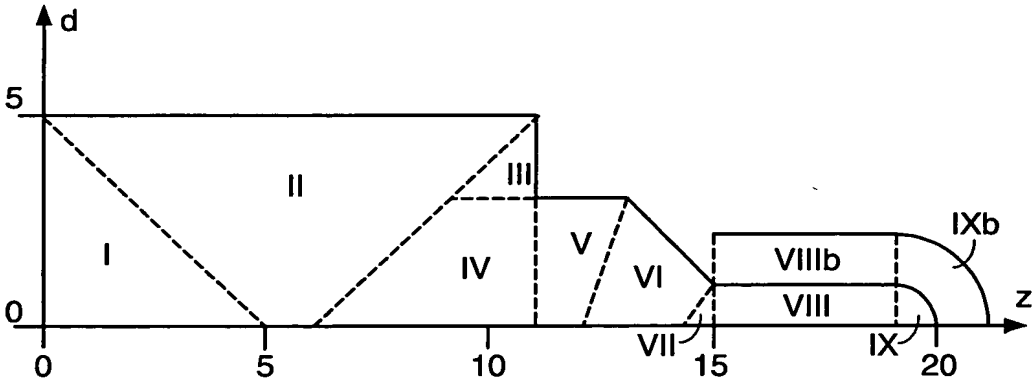
AXIALLY SYMMETRIC TOOL REPRESENTED BY TWO VARIABLE EQUATION

FIG. 5A



REGIONS OF THE AXIALLY SYMMETRIC TOOL

FIG. 5B



REGIONS OF THE AXIALLY SYMMETRIC TOOL.

FIG. 5C